CLAIMS

1. A method of generating an metallic ion source, comprising:

heating an inert carrier gas;

vaporizing a metallic element or metallic element salt in the presence of the heated inert carrier gas;

transporting the vaporized metallic element or salt in the heated inert carrier gas to a temperature-controlled ionization chamber; and

ionizing the vaporized metallic element or salt in the chamber in the presence of the heated inert carrier gas to generate ions of the metal.

2. The method of claim 1, further comprising extracting an ion beam from the chamber.

3. The method of claim 1, wherein the carrier gas is heated to a temperature at which the vapor pressure of the metallic element or salt of at least 0.01 mTorr.

4. The method of claim 1, wherein the carrier gas is heated to a temperature at which the vapor pressure of the metallic element or salt of at least 5 mTorr.

5. The method of claim 3, wherein the carrier gas is heated to a temperature between about 100 and 1000°C.

6. The method of claim 3, wherein the ionization chamber is heated to about the same temperature as the carrier gas.

7. The method of claim 1, wherein the chamber is heated at least in part by resistive heating elements in or on the chamber walls.

8. The method of claim 1, wherein the inert carrier gas is Ne.

9. The method of claim 7, wherein the metallic element or salt is selected from the group consisting of alkaline earth metals and transition metals with vapor pressures greater than 0.01 mTorr at temperatures below 1000°C, and salts thereof.

10. The method of claim 1, wherein the ionization is a photo-ionization.

11. The method of claim 10, wherein the photo-ionization is conducted with light having a wavelength of about 600 to 2100 Å.

12. The method of claim 11, wherein the carrier gas is not ionized.

13. The method of claim 2, further comprising conducted ion implantation of a substrate with the ion beam.

14. The method of claim 13, wherein the ion beam comprises ions of a metallic element is selected from the group consisting of Ca, Sr, Ba, Cd, Zn and Mn.

15. The method of claim 14, wherein the substrate is a material selected from the group consisting of silicon, SiO_2, ZnO_2 and HfO_2.

16. The method of claim 15, wherein the metallic element is Ca and the substrate is SiO_2.

17. An apparatus for vaporizing and ionizing a metallic element or metallic element salt, comprising:

a carrier gas heating chamber configured to heat an inert carrier gas to a temperature in the range of 100 to 1000°C;

a vaporizer chamber, connected with the carrier gas heating chamber, and configured to vaporize a metallic element in the presence of the inert carrier gas heated in the carrier gas heating chamber; and

an ionization chamber connected with the vaporizer chamber, the ionization chamber having surfaces heated to prevent deposition of the vaporized metallic element or salt thereon, and configured to ionize the vaporized metallic element in the presence of the inert carrier gas heated in the carrier gas.

18. The apparatus of claim 17, wherein the ionization chamber surfaces contain or contact resistive heating elements.

19. The apparatus of claim 18, further comprising a photo-ionization source appended to the ionization chamber.

20. The apparatus of claim 19, wherein interior surfaces of the ionization chamber have a mirror finish.

21. The apparatus of claim 20, wherein a sheet of glass separates the light source from the ionization chamber.

22. The apparatus of claim 21, wherein the sheet of glass comprises embedded resistive heating elements.

23. The apparatus of claim 22, wherein the sheet of glass has a one way mirrored surface facing the ionization chamber interior.